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Information on Atlantic salmon (*Salmo salar*) from Salmon Fishing Area 15 (Gulf New Brunswick) of relevance to the development of the COSEWIC status report

Renseignements sur le saumon de l'Atlantique (*Salmo salar*) de la zone de pêche du saumon 15 (Golfe Nouveau-Brunswick) en vue de la préparation du rapport de situation par le COSEPAC

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ABSTRACT

This document presents information on Atlantic salmon (*Salmo salar*) from Salmon Fishing Area (SFA) 15 (northern New Brunswick in DFO Gulf Region) of relevance to the development of the status report by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). There are 15 recognized Atlantic salmon rivers in this area of which the Restigouche River is the largest river. Data are presented and interpreted relative to the following: biological characteristics, stocking of fish, area of occupancy based on juvenile surveys, indicators of adult abundance for monitored rivers, freshwater production based on juvenile surveys and smolt production, and factors which may be constraining Atlantic salmon abundance. For the rivers in this area, the indices of adult abundance suggest that there were more salmon in the mid to late 1980s than there have been in the past 15 years. As a result of changes in fisheries management, spawning escapement has increased from the 1970s and early 1980s resulting in increased abundance of juvenile salmon. The principal threats are: habitat alteration including habitat fragmentation due to non compliant culverts, hydroelectric power generation and cumulative effect of ecosystem changes.

RÉSUMÉ

Le présent document donne des renseignements sur le saumon de l'Atlantique (*Salmo salar*) de la zone de pêche du saumon (ZPS) 15 (nord du Nouveau-Brunswick dans la région du golfe du MPO) en vue de la préparation du rapport de situation par le Comité sur la situation des espèces en péril au Canada (COSEPAC). Cette région comporte 15 rivières à saumon, dont la plus importante est la rivière Restigouche. Les données présentées et interprétées se rapportent aux éléments suivants : caractéristiques biologiques, stock de poissons, superficie occupée en fonction des inventaires des juvéniles, indicateurs de l'abondance des adultes dans les rivières étudiées, production en eau douce en fonction des inventaires des juvéniles et de la production de saumoneaux et facteurs nuisant à l'abondance du saumon de l'Atlantique. Les indices d'abondance des géniteurs dans les rivières de cette région suggèrent que la population de saumon était plus abondante du milieu à la fin des années 1980, que dans les 15 dernières années. Les changements apportés à la gestion des pêches dans les années 1970 jusqu'au début des années 1980 ont entraîné une augmentation du nombre d'échappées des géniteurs, ce qui a causé une hausse d'abondance de saumons juvéniles. Les principales menaces sont les suivantes : altération de l'habitat, notamment la fragmentation due à l'utilisation d'aqueducs non conformes, les installations hydroélectriques et l'effet cumulatif des modifications de l'écosystème.

INTRODUCTION

This document presents information on Atlantic salmon (*Salmo salar*) from Salmon Fishing Area (SFA) 15 of relevance to the development of the status report by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). SFA 15 is located in northern New Brunswick within the DFO Gulf administrative region. There are 32 potential Atlantic salmon rivers in this area, of which 15 have freshwater habitat areas quantified (Table 1; Fig. 1). The Restigouche River is the largest river in the area (Table 1; Fig. 1). The Matapedia River, a major tributary in the lower portion of the Restigouche, is assessed separately by the province of Québec. Most of the other rivers are comparatively small with fresh water habitat areas of less than one million m^2 (Table 1). A number of smaller rivers in this SFA are not recognized as Atlantic salmon rivers but they may have small runs of Atlantic salmon which are not exploited (Table 1).

The conservation limit reference point for the Restigouche River watershed is an egg deposition rate of 1.67 eggs per productive habitat unit (m^2) that will provide maximum sustainable yield of adult salmon. This value is the same reference level used by the province of Québec for managing Atlantic salmon (Caron et al. 1999). Habitat area for juvenile production has recently been updated through interpretation of aerial photos. The province of Québec has evaluated the habitat value of the main stem of the Restigouche River as well as the Matapedia and Patapedia rivers using the habitat characteristics and weighting described by Caron et al. (1999). Habitat area for the Restigouche River (excluding Matapedia) totals 21.62 million m^2 with an additional habitat area for the Matapedia River of 6.81 million m^2 of wetted area equivalent to 5.12 million m^2 of productive habitat units. At an egg deposition rate of 1.67 eggs per m^2 (deposition rate for the rivers of the province of Québec), conservation requirements in terms of eggs are 44.66 million eggs, equivalent to 7,000 large salmon (at an average of 6,400 eggs per large salmon). This value is 58% of the conservation requirement previously reported for the Restigouche River (12,042 large salmon; Randall 1984).

For the other rivers in this area, the default conservation limit egg deposition rate of 2.4 eggs per m^2 is used and applied to estimates of wetted area (Table 1). Egg requirements to 11 of these 14 other rivers are less than 1.5 million eggs or roughly less than 250 large salmon.

BIOLOGICAL CHARACTERISTICS

Smolt age varies from 90% two-year old smolts in Nepisiguit River (Mowbray and Locke 1998) to 70% three-year old smolts in the Restigouche River (Tables 2 and 3). The proportion of four-year old smolts in the Restigouche River has decreased from just under 10% for 1972 to 1981 (Pickard 1983) to 4% for the last five years (Chaput et al. 2004).

Small salmon (< 63 cm fork length) are almost exclusively males, and usually comprise less than 50% of the returns to these rivers. Large salmon (>= 63 cm fork length) include two-sea-winter (2SW) and three-sea-winter (3SW) maiden spawners, as well as repeat spawners. Four-sea-winter (4SW) maiden salmon have been interpreted from scales collected on salmon from the Restigouche River (Peppar and Pickard 1975; Pickard 1983) and both 4SW and one sample of a five-sea-winter (5SW) maiden salmon were reported from the Nepisiguit River (Mowbray and Locke 1998). The large salmon group are most often greater than 70% female (Tables 2, 3).

Adult salmon in samples from the Restigouche River range in length from about 48 cm to over 120 cm (Fig. 2). By sea age history, one-sea-winter (1SW) salmon have an average fork length of 54.3 cm (90% C.I. 49 to 60 cm) and 2SW salmon have an average fork length of 77 cm (90%

C.I. 69 to 86 cm) whereas 3SW maiden salmon averaged 93 cm fork length (90% C.I. 85 to 100 cm) (Fig. 3). Corresponding predicted mean whole weights of 1SW, 2SW and 3SW salmon are 1.6, 4.5, and 8.8 kg, respectively (Fig. 4). Repeat spawning salmon are also common from the rivers in this SFA with 11 years the oldest age of salmon reported by Pickard (1983). Population monitoring does not allow the calculation of the mean generation time but given the importance of three year old smolts and the abundance of 3SW salmon in the adult returns, mean generation time would be close to 6 years.

Egg to fecundity relationship for Restigouche River salmon has been published by Randall (1989). Large salmon (sexes combined) have a fecundity of about 6,400 eggs per fish.

Most salmon return to the Restigouche prior to September 1 with the first bright salmon in the river by mid to late May. Salmon continue to ascend to the spawning areas into October. Salmon are counted through the Jacquet River and Nepisiguit River counting facilities into late October.

Salmon from rivers in SFA 15 undertake long oceanic migrations as shown by recoveries of tagged salmon from these rivers at West Greenland. Salmon tagged as smolts from the Restigouche River have been intercepted at West Greenland in recent years.

INFORMATION TO SUPPORT PROPOSALS OF DESIGNATABLE UNITS

Stocking of several rivers of SFA 15 with Atlantic salmon of various life stages has occurred since the government of the day established a fish culture facility on the Restigouche River in 1874 (Table 4). The Restigouche facility was operated by the government of Canada at subsequent locations in Deeside, Flatlands and Charlo in New Brunswick until it was divested to a private "not for profit" organization in 1998. This non-profit organization has continued to operate the Charlo hatchery and conduct similar stocking programs as the previous operator. A subsidiary hatchery facility also was established by the federal government on the Nepisiguit River in 1914 and operated for some years.

An examination of early reports indicates that most stocking occurred at the early life stages of fry, advanced fry and fingerlings. The reports also indicate that eyed Atlantic salmon eggs were routinely transferred from one government hatchery facility to another. For example it was common for eggs of Chaleur Bay and Restigouche origin to be transferred to hatcheries located at Grand Falls and Florenceville on the Saint John River system for grow out and stocking. Similarly the reports indicate that eyed eggs of Miramichi origin were transferred to the Restigouche hatchery for grow out and stocking. These records also indicate that the majority of broodfish were of early run, captured near the New Brunswick shore of the Chaleur Bay and purchased from the commercial fisherman of the district and held and spawned at the government owned New Mills holding pond which had been constructed prior to 1919 (Department of Fisheries, Annual Report on Fish Culture 1937). Broodfish were also captured from the Restigouche River and held in the river in floating cages called pontoons prior to spawning from the early 1940's until the government holding pond was constructed in the early 1960's at Hailes Brook adjacent to the Restigouche River. In recent years, 1980 to present, discrete tributary/river stocks were captured by various methods and the subsequent progeny utilized in area salmon enhancement programs.

Hatchery stocking was especially important in the Nepisiguit River with modest stocking programs in the Restigouche River. An active stocking program has been carried out in the Nepisiguit River for the past three decades, initially to restore the population following a spill of mining waste and overfishing, and subsequently for enhancement purposes (Locke 1998).

Stocking still occurs in the Nepisiguit and Restigouche rivers. Returns to the Restigouche River from stocking programs are considered to be less than 1% of total returns. Hatchery-origin salmon have represented important proportions of the returns to the Nepisiguit River, as high as 75% of both small and large salmon (Locke et al. 1994) but the hatchery contribution to this river is much reduced in recent years (Chaput et al. 2006).

AREA OF OCCUPANCY

To confirm the area of occupancy of Atlantic salmon, 196 sites in 32 rivers of SFA 15 were surveyed by electrofishing for the presence of juvenile Atlantic salmon in 2008 (Fig. 5). Most of the sites were sampled by DFO Science teams but crews from the Nepisiguit Salmon Association sampled six of the rivers. A river is defined as emptying into an estuary or ocean.

Juvenile salmon are distributed throughout SFA 15. Juveniles were not captured in 13 of these rivers (at 34 of 196 sites) (Table 1; Fig. 5). Most of the rivers without salmon juveniles were very small rivers and in many cases, absence of juveniles was due to the presence of natural obstructions such as waterfalls and beaver dams, or the streams are too small for ascension of adult salmon. In one river, Little River (near Bathurst), salmon cannot survive due to toxic conditions (see Threats section).

In many rivers surveyed, two or three cohorts (fry, small parr, large parr) were captured indicating that there had been multiple years of spawning success (Fig. 5).

Long term juvenile abundance surveys completed on Restigouche (New Brunswick) provide an indication of the temporal changes in juvenile salmon presence and abundance, from 1972 to 2008. In the Restigouche River, there has been varying levels of site occupancy by salmon fry with no trend in the proportion of sites sampled which had densities > 1.0 fish per 100 m^2 (Fig. 6). There was a significant increasing trend in the proportion of sites which had large parr (age-2+ years) at densities greater than 1 fish per 100 m^2 (Fig. 6).

POPULATION SIZE, STATUS AND TRENDS

Information sources sought/considered

Information on adult salmon abundance comes primarily from angling catches and effort (Table 5). End of season spawner counts have been conducted in some years on the Restigouche River and counts of salmon to a headwater tributary are available for two tributaries of the Restigouche River (Table 6; details in Chaput et al. 2000). A counting barrier on the Jacquet River near the head of tide provides incomplete counts of adults in most years (Table 7). A counting fence has been operated on the Nepisiguit River over the past three decades but installation dates, operational details and washouts have comprised the completeness of the data (Locke et al. 1994; Locke et al. 1997a,b). Juvenile surveys have been conducted annually in the Restigouche River since 1972 (Tables 8 – 10) and abundance indices of juveniles are available for some years from the Jacquet River and the Nepisiguit River. Smolt assessment programs began in 2002 to assess the production and characteristics of smolts from tributaries and from the Restigouche River overall (Chaput et al. 2004).

Abundance and trends are evaluated relative to the recent 16 years, 1993 to 2008. This time period has been chosen because it roughly represents 3 generations and also corresponds to the years since the moratorium on salmon commercial fishing in insular Newfoundland.

Abundances are also put in context of the longer time period when available. Trend in an abundance index (Ln(Index)) is characterized as the instantaneous rate of change (Z) over the period 1993 to 2008. Abundance of the 16 year period is expressed as the percent change using $100*(\exp^{Z*16}-1)$.

Abundance and recent trends

Abundance of adult salmon in the Restigouche River is inferred from angling catches, counts at headwater barriers, and when possible from end of year spawner counts by snorkeling (Table 2; Chaput et al. 2000).

Counts at the two headwater barriers indicate a 50% decline in abundance in the Northwest Upsalquitch River tributary whereas at the Causapscal River barrier (tributary of the Matapedia) there has been a slight increase over the same period (Table 5; Fig. 7).

Catch per unit effort indices from the recreational fishery suggest an increase for small salmon but a slight decrease for large salmon from the Matapedia tributary for the period 1993 to 2008 (Fig. 8). On average, over 7,000 salmon are angled annually in the Restigouche River (Table 5; Fig.9).

Other rivers

Over the last two decades, assessment data have also been collected from the Jacquet River and the Nepisiguit River (Table 3). Counts of salmon at a protection barrier near the head of tide on the Jacquet River have frequently been incomplete due to washouts or late installations (Table 7). Adult abundance in the Jacquet River has exceeded the conservation requirement at the start of the time series but in recent years, its status relative to conservation is unknown due to frequent washouts, especially in the fall (Fig.10).

The status of the Nepisiguit River has been uncertain. Estimates of returns and escapements based on fence counts which are generally incomplete indicated that conservation requirements had been achieved in only 2 of 15 years when the stock was assessed (1982 to 1996) (Locke et al. 1997a,b) but estimates based on redd counts in late fall collected by the Nepisiguit Salmon Association indicated that spawning escapement had been around the conservation requirements since 1994 (DFO 2001).

Freshwater production

Juvenile abundance in the Restigouche River has been monitored annually since 1972. Densities of fry, small parr and large parr all increased post-1984 and remain at high levels (Fig. 11). Fry abundance since 1993 shows a slight decrease whereas small parr and large parr show strong increases in density (Tables 8-10; Fig.11). All sites sampled have become and remain occupied by juveniles with the exception of some small streams which are prone to periodic blockages to spawners by beaver dams. The Matapedia River time series is shorter, starting in 2000, and densities of juveniles are at comparable levels to those of the Restigouche (NB) sites. The water levels in 2008 were unusually high throughout the summer and fall. Results from juvenile salmon surveys in 2008, which showed decreased abundance of all age classes, could be biased due to difficult sampling conditions (extremely high water) rather than an indicator of actual lower abundance.

Smolt production in the Kedgwick River has varied between 1.9 and 3.8 smolts per 100 m^2 during 2003 to 2008 whereas production from the Restigouche River overall has varied from 1.4 to 4.1 smolts per 100 m^2 (400 thousand to 1.1 million smolts) (Table 11). Based on a rough estimate of adult returns to the Restigouche during 1999 to 2003, the smolt production rate is in the order of 50 smolts per large salmon return.

Other rivers

Salmon fry densities in the Nepisiguit River have increased since the 1980s whereas parr abundance has declined (Fig.12). Juvenile abundances in the Jacquet River are at comparable levels to those of the Restigouche River (Fig.13).

There are no measures of marine return rates for any rivers in this area.

STATUS

A number of qualitative indicators have been used to infer whether conservation requirements were met. Based on the requirement of 7,000 large salmon and an assumed catch rate of 30% in the angling fishery, conservation would have been met in 13 of 16 years since 1992 (Table 2). In the Matapedia River, conservation has been achieved every year since 1994 (Table 2). Spawning escapements above conservation are consistent with the sustained high densities of juveniles in the Restigouche River.

In all these rivers, the indices of adult abundance suggest that there were more salmon in the mid to late 1980s than there have been in the past 15 years. As a result of changes in fisheries management, particularly the closure of the Maritime provinces and Quebec commercial fisheries and the mandatory catch and release measures in the angling fishery since 1984, spawning escapement has increased which has resulted in increased abundance of juvenile salmon.

Estimates of total abundance of salmon in SFA 15

Estimates of total abundance (returns and spawners) of adult salmon in SFA 15 are derived from indicators in the Restigouche River, the major river in this area. The returns and spawners are estimated for the Restigouche River, exclusive of returns to the Matapedia River which are included in Quebec zone Q1.

The Restigouche River stock assessment is based on angling catch with assumed exploitation rates between 30% (min.) and 50% (max) with estuary catches added to the estimates of returns. In 2001 to 2008, no corrections to returns for estuary catches were made.

Return and spawner estimates for SFA 15 are based on Restigouche River data, scaled up for SFA 15 based on the ratio of total SFA 15 to Restigouche River angling catches. The minimum and maximum return and spawner estimates are derived from the minimum and maximum ratios of angling catch in all of SFA15 relative to angling catch in Restigouche (New Brunswick) (min = 1.117; max = 1.465) (Tables 12, 13).

Harvests represented retained angling catch plus 6% catch and release mortality for released fish. For the purposes of developing catch advice for the high seas fisheries, estimates of 2SW returns and spawners are derived using the proportion of 2SW in large salmon, based on aged

scale samples from angling, trapnets, and broodstock. No scale samples analysis was available for 1970, 1971, 1995, and 1996 to 2008 and the mean value of 0.65 is used.

Values for 2007 were updated and values for 2008 are preliminary.

Estimated total abundance in SFA 15 of small salmon has increased by 44% and for large salmon by 18% over the past 16 years (Fig. 14). There is a very large variability in estimates of small salmon returns which are driven by the variations in small salmon angling catches reported from the Restigouche River. Although large salmon abundance is estimated to have increased over the past 16 years, the average abundance over that period (about 6,000 fish) is only 60% of the estimated abundance over the previous period 1970 to 1992 (Fig. 14). This contrasts with the small salmon abundance estimate of over 10,000 fish over the recent 16 years, 20% higher than the mean value estimated for the period 1970 to 1992 (Fig. 14).

The abundance of fry does not correspond to the increased adult abundance estimated from angling catches over the past 16 years. The fry abundance index (in year i) would be expected to correspond to the adult spawner estimate of the previous year (year i-1) so the overall estimate of adult abundance for SFA 15 should be interpreted with caution.

THREATS

In the context of the identification and management for species at risk, a *threat*, is 'an activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioral changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur' (Environment Canada 2006). In essence, it is an activity that imposes a *stress* on a species at risk population which contributes to or perpetuates its decline, or limits its recovery. In the case of Atlantic salmon, the elevated marine mortality and declining returns in recent years are stress caused by unknown (but hypothesized) threats.

A semi-quantitative assessment of the impact of habitat-related threats to salmon is summarized in Table 14. The principal threats are: habitat alteration including habitat fragmentation due to non compliant culverts, hydroelectric power generation including dams and reservoir on the Nepisiguit and cumulative effect of ecosystem changes (DFO and MNRF *In prep b.*). These threats represent a loss of 5 to 30% of spawners. All other threats represent less than 5 % of spawners lost. Many of these activities can be regulated under various Sections of the *Fisheries Act*.

Cairns (2001) presents and describes 62 hypotheses which may explain the decline in abundance of Atlantic salmon. Any or all of the factors described may be acting to constrain present abundance of Atlantic salmon in the Gulf rivers. A few of these factors are discussed below.

Fisheries

Losses of large salmon from fisheries are considered low, restricted to First Nations fisheries and from incidental mortalities associated with catch and release fisheries. Exploitation on egg bearing females is low to moderate (Table 14). Although salmon from SFA 15 rivers continue to be intercepted in the West Greenland fishery, the rate of exploitation is presumed to be very low compared to levels during the peak of the fishery in the 1960s to 1980s.

Disease

There is history of outbreaks of the fish disease furunculosis, caused by the bacterium *Aeromonas salmonicida*. Mortalities on salmon in the Restigouche River were most important in the 1970s when hundreds of fish were reported dead during warm and low water events. Since then, annual mortalities have declined despite the confirmed presence of furunculosis in some diagnosed fish.

Land Use

Forestry, agriculture, and rural development all impact in various ways the fresh water habitat of Atlantic salmon. A restocking program was initiated in the Nepisiguit River following a spill of mining waste.

The Little River (Bathurst) is perpetually toxic to salmon as the stream is heavily polluted by base metal mining effluents.

Fish passage

Several rivers in this area have natural impassable falls at varying distances from the ocean, limiting access to salmon: South Charlo River, Millstream, Tetagouche River, Nepisiguit River.

There are a few rivers and tributaries with water control structures which impede the migration of Atlantic salmon. These are located at the mouth of the Eel River and the Charlo River approximately five kilometers upstream from the mouth. Dewatering of juvenile rearing areas during low flow conditions happens frequently in a short portion of the Charlo River.

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Table 1. Rivers characteristics for Salmon Fishing Area 15. Source of evidence of salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Presence/absence for juveniles was surveyed in 2008. Habitat areas are from various published and unpublished sources and summarized in Chaput et al. (2006).

Map index number	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile	Angling
1	Restigouche	-66.7830	47.9910	44.93	6,589	26.7439	X	X	X
2	Eel River	-66.3667	48.0167	1.01	116	0.4220	X	X	X
3	Charlo	-66.2833	47.9833	1.44	400	0.5996	X	X	X
4	South Charlo	-66.2825	47.9851					X	
5	Blackland Brook	-66.2131	47.9717					Absent	
6	New Mills	-66.1841	47.9677					Absent	
7	Benjamin	-66.1667	47.9667	0.58	161	0.2410		X	X
8	Nash Creek	-66.0846	47.9232					Absent	
9	Louison River	-66.0633	47.9270					X	
10	Jacquet	-66.0167	47.9167	2.72	510	1.1350	X	X	X
11	Armstrong Brook	-65.9870	47.9151					Absent	
12	Patapat Brook (Belledune)	-65.8919	47.9126					Absent	
13	Fournier Brook	-65.7613	47.8522					Absent	
14	Elmtree River	-65.7319	47.8046					X	
15	Little Elmtree River	-65.7235	47.7933					Absent	
16	Nigadoo	-65.7167	47.7500	0.60	168	0.2520		X	X
17	Millstream	-65.7000	47.7000	0.83	229	0.3440		X	X
18	Peters River	-65.6849	47.6652					Absent	
19	Tetagouche	-65.6833	47.6333	0.72	364	0.2990		X	X
20	Middle (Gloucester co)	-65.6667	47.6000	2.28	401	0.9500		X	X
21	Little River	-65.6691	47.5956					*Toxic*	
22	Nepisiguit	-65.6333	47.6167	9.54	2,312	3.9730	X	X	X
23	Bass (Gloucester co)	-65.5833	47.6667	0.71	198	0.2973		X	X
24	Miller Brook	-65.5036	47.6686					Absent	
25	Teagues Brook	-65.4492	47.6891					X	
26	Little Pokeshaw River	-65.2867	47.7837					Absent	
27	Pokeshaw River	-65.2469	47.7842					Absent	
28	Riviere du nord	-65.1268	47.7872					Absent	
29	Caraquet	-65.0667	47.7833	1.34	373	0.5596	X	X	X
30	Pokemouche	-64.8000	47.6667	0.60	481	0.2480	X	X	X
31	Little Tracadie	-64.9000	47.5167	0.69	192	0.2885		X	X
32	Tracadie	-64.8667	47.4833	1.44	527	0.6010	X	X	X

Table 2. Summary of status indicators and trends for Restigouche River in SFA 15. Trend indicators are for the past 16 years (1993 to 2008).

Indicator	Life stage	Restigouche		Matapedia	
		Level in past 5 years	Trend (1993 to 2008)	Level in past 5 years	Trend (1993 to 2008)
Angling catch	Adult	6,192	+ 39%	1,591	+ 22%
CPUE (fish per rod day)	Adult	0.64	+ 69%	0.20	- 10%
Barrier counts	Adult	1,001	- 50%	393	+ 21%
Juvenile abundance (fish / 100 m²)	Fry	44	- 50%	43	
	Small parr	15	+ 9%	15	
	Large parr	6	+ 134%	8	
	Distribution of juveniles	Found at all sites (N = 65 to 79 annually)	All sites remain occupied	Found at all sites (N = 13 to 27 annually)	
Returns relative to conservation requirements		Qualitative indicator, met in most years	Presumably met in most years	157% to 226%	Met in 14 of 16 years
Large salmon in returns	Adult	55%		65%	
Maiden salmon in returns	Adult	94%			
Maiden age structure 1SW-2SW-3SW	Adult	51%-39%-11%			
Smolt ages 2-3-4-5	Smolt	27%-70%-4%-0			
Percent female in 1SW-2SW-3SW	Adult	7%-67%-80%			
Fork length (cm) of 1SW-2SW-3SW		54 - 76 - 92			

Table 3. Summary of status indicators and trends for the Nepisiguit River and Jacquet River of SFA 15.

		Nepisiguit		Jacquet	
	Life stage	Level in 2000 to 2004	Trend (1992 to 2006)	Level in 2004 to 2008	Trend (1993 to 2008
Angling catch	Adult				
CPUE (fish per rod day)	Adult				
Barrier counts	Adult			446 (incomplete counts)	-65% (based on incomplete counts
Juvenile abundance (fish / 100 m²)	Fry	33	+40%	86	
	Small parr	5	- 51%	17	
	Large parr				
	Distribution of juveniles	N = 11 to 12 sites	N = 6 to 13 sites	N = 6 sites	
Returns relative to conservation requirements		At or above for most years assessed	At or above since 1994 (based on redd counts)	Incomplete counts owing to numerous washouts	
Large salmon in returns	Adult	50%		48%	
Maiden salmon in returns	Adult	91%			
Maiden age structure 1SW-2SW-3SW	Adult	62% - 27% - 11%			
Smolt ages 2-3-4-5	Smolt	90% - 10% - 0 - 0			
Percent female in 1SW-2SW-3SW	Adult	5% - 51% - 79%			
Fork length cm) of 1SW-2SW-3SW		55 – 78 - 93			

Table 4. Stocking activities history for rivers of SFA 15.

River	Longitude (W)	Latitude (N)	Origin of fish stocked	Life stages of fish stocked	Range in annual numbers of fish stocked	Range in years when stocking occurred
Restigouche	-66.3333	43.0667	Chaleur Bay & Restigouche	Fry, parr	50,000 – 2,200,000	1875-1975
			Restigouche	Fry, parr	5,000 – 600,000	1977-2008 no stocking 1976, 1978-82
Charlo	-66.2833	47.9833	Chaleur Bay & Restigouche	Fry, parr	13,000-128,000	1962-1968
South Charlo	-66.2825	47.9851	Chaleur Bay & Restigouche	Fry, parr	200-34,000	1961-1970
Jacquet	-66.0167	47.9167	Chaleur Bay & Restigouche	Fry, parr	2,000 – 355,000	~1937-1972
			Jacquet	Fry, parr	5,000-37,000	1996-2008
Tetagouche	-65.6833	47.6333	Chaleur Bay & Restigouche	Fry, Parr	7,000-145,000	1958-1975
			Nepisiguit	Fry	2,400 - 50,000	1994-2003
Middle (Gloucester co)	-65.6667	47.6000	Chaleur Bay & Restigouche	Fry, parr	5,000 – 146,000	~1937-1967
Nepisiguit	-65.6333	47.6167	Chaleur Bay & Restigouche	Fry, parr	1,000 - 600,000	1914 -1975
			Restigouche	Fry, parr, smolts	16,000 – 160,000	1982-1985
			Miramichi	Fry, parr, smolts	8,000 – 770,000	1981-1986
			Nepisiguit	Fry, parr smolts	6,000 – 850,000	1976-2008
Bass (Gloucester co)	-65.5833	47.6667	Chaleur Bay & Restigouche	Fry, parr	500-118,000	1962-1969
Caraquet	-65.0667	47.7833	Chaleur Bay & Restigouche	Fry, parr	6,00-19,000	1968-1971
Little Tracadie	-64.9000	47.5167	Chaleur Bay & Restigouche	Fry, parr	6,000-19,000	1968-1971
Tracadie	-64.8667	47.4833	Chaleur Bay & Restigouche	Fry, parr	1,000-241,000	1958-1973
			Tracadie	Fry, parr	4,500	1993-1994

Table 5. Angling catch and effort from the Restigouche River 1982 to 2008. NB refers to the Restigouche River excluding the Matapedia River. Data for 2008 are preliminary.

	Large Salmon			Small Salmon			Effort (rod days)		
	NB	Matapedia	Total	**NB**	Matapedia	Total	**NB**	Matapedia	Total
1982	1,756	841	2,597	2,661	259	2,920	10,998		
1983	1,613	456	2,069	745	154	899	10,301		
1984	1,716	560	2,276	1,503	285	1,788	8,085	4,852	12,937
1985	3,607	807	4,414	3,311	291	3,602	11,272	5,581	16,853
1986	4,894	1,289	6,183	5,100	389	5,489	11,010	6,888	17,898
1987	3,258	915	4,173	4,508	602	5,110	11,127	7,816	18,943
1988	4,607	1,068	5,675	6,193	680	6,873	11,998	7,457	19,455
1989	3,484	1,119	4,603	2,934	466	3,400	10,313	7,816	18,129
1990	2,879	856	3,735	3,669	718	4,387	12,007	7,064	19,071
1991	2,197	940	3,137	2,095	521	2,616	9,831	6,650	16,481
1992	3,389	966	4,355	4,185	693	4,878	10,643	6,271	16,914
1993	1,550	505	2,055	2,734	735	3,469	10,748	6,052	16,800
1994	3,062	917	3,979	4,306	822	5,128	10,764	8,093	18,857
1995	1,963	829	2,792	1,372	337	1,709	10,524	6,404	16,928
1996	2,898	922	3,820	2,853	721	3,574	11,287	7,001	18,288
1997	1,812	689	2,501	2,741	450	3,191	11,970	7,565	19,535
1998	1,173	441	1,614	2,973	650	3,623	11,966	6,907	18,873
1999	1,235	587	1,822	2,331	707	3,038	11,380	6,391	17,771
2000	1,586	683	2,269	3,524	853	4,377	8,780	7,252	16,032
2001	2,694	1,067	3,761	2,336	615	2,951	9,272	7,927	17,199
2002	1,622	507	2,129	5,538	1,317	6,855	9,450	8,467	17,917
2003	2,818	891	3,709	1,472	531	2,003	10,343	8,545	18,888
2004	2,119	840	2,959	5,714	1,153	6,867	10,917	8,573	19,490
2005	2,429	909	3,338	1,944	579	2,523	9,994	8,742	18,736
2006	1,782	633	2,415	4,122	1,025	5,147	9,064	8,670	17,734
2007	3,056	765	3,821	2,011	438	2,449	10,304	7,968	18,272
2008	1,808	513	2,321	5,973	1,099	7,072	8,746	8,329	17,075

Table 6. Annual counts of small salmon and large salmon at fences and protection barriers within the Restigouche River watershed.

	Northwest Upsalquitch			Causapscal (Matapedia)		
Year	Small	Large	Total	Small	Large	Total
1980	843	887	1730			
1981	789	481	1270			
1982	819	622	1441			
1983	430	301	731			
1984	518	642	1160			
1985	748	517	1265			
1986	1738	1166	2904			
1987	1557	1000	2557			
1988	1121	993	2114	49	505	554
1989	1051	894	1945	7	605	612
1990	1324	946	2270	37	456	493
1991	1267	930	2197	9	451	460
1992	1351	963	2314	8	350	358
1993	957	353	1310	12	256	268
1994	1329	740	2069	3	349	352
1995	817	946	1763	1	462	463
1996	959	587	1546	4	441	445
1997	1027	461	1488	2	229	231
1998	834	494	1328	4	215	219
1999	814	619	1433	25	518	543
2000	710	399	1109	30	332	362
2001	409	363	772	25	393	418
2002	955	209	1164	39	291	330
2003	440	672	1112	43	420	463
2004	1026	233	1259	12	421	433
2005	*410*	*329*	739 [1]	13	346	359
2006	689	305	994	20	465	485
2007	242	318	560	6	279	285
2008	*1119*	334	1453 [1]	41	362	403
Mean 2003-2007	704	350		25	389	414
2008 vs mean	-65.6%	-9.0%		-76.4%	-28.2%	-31.2%
Trend (1993-2008)						
instantaneous	-0.0479	-0.053	-0.0462		0.009	0.01290
change over period	-51%	-55%	-50%		14%	21%

[1] incomplete count due to major washout in the fall (Sept. or Oct.)

Table 7. Counts of small salmon and large salmon at the Jacquet River barrier fence, SFA 15.

	Returns			
Year	Small salmon	Large salmon	Dates of operation	Comments
1994	613	595		
1995	344	589		
1996	634	359		
1997	372	384		
1998	402	298		
1999	not available			
2000	209	252	July 6 to Oct. 29	washouts in October
2001	245	184	Aug. 2 to Oct. 31	about 45 fish holding below fence
2002	340	136	Aug. 1 to Oct. 31	about 350 fish holding below fence
2003	170	601	June 19 to Oct. 29	about 200 fish holding below fence
2004	229	185	June 17 to Oct. 27	about 125 fish holding below fence
2005	118	138	June 16 to Sept. 27	Washout Sept. 27 to Oct. 4
2006	473	338	June 15 to Oct. 20	about 200 fish holding below fence
2007	137	201	June 14 to Oc.t 24	Washout on Oct. 13
2008	308	105	June 19 to Oct. 22	Washouts after June 20, Aug. 1 Sept. 30

Table 8. Mean density (fish per 100 m²) of Atlantic salmon fry by tributary of the Restigouche River.

Year	Kedgwick	Little Main	Patapedia	Upsalquitch	Matapedia	Main stem
1972	5.1	3.4		3.8		9.0
1973	22.0	18.4		15.6		10.6
1974	13.5	15.5		13.4		5.3
1975	36.5	19.7		50.7		37.8
1976	16.5	5.8		22.8		23.9
1977	12.3	21.0		18.1		16.0
1978	11.4	30.5		33.2		18.1
1979	7.8	6.9		20.6		8.0
1980	10.4	10.5		13.7		7.7
1981	19.0	14.7		20.4		11.9
1982	11.4	4.9		12.4		4.7
1983	20.3	26.4		34.4		14.8
1984	21.2	28.8		23.9		26.8
1985	22.2	20.4		27.7		22.4
1986	20.3	32.6		23.6		16.2
1987	45.9	31.7				51.9
1988	67.6	32.1				48.6
1989	85.8	57.4				53.9
1990	70.3	26.0				52.7
1991	132.3	119.1				48.9
1992	58.2	45.5				40.7
1993	50.2	55.7				45.4
1994	57.4	81.4				27.4
1995	79.0	78.7				33.4
1996	54.0	35.5				26.4
1997	90.3	71.2		59.5		24.0
1998	64.2	79.7		116.6		74.2
1999	75.8	95.7		112.9		69.9
2000	107.6	129.0		129.3		75.5
2001	49.1	51.5	62.5	39.4	75.7	29.4
2002	58.4	93.4	108.6	60.7	71.9	53.1
2003	48.0	28.5		33.7		33.5
2004	32.0	75.8	49.1	69.3	29.8	50.1
2005	80.0	68.9	72.5	47.1	56.4	44.9
2006	30.7	80.6	60.6	63.9	55.1	42.8
2007	31.3	33.6	69.5	43.7	42.3	22.9
2008	20.1	14.1	53.2	30.0	29.0	17.5

Table 9. Mean density (fish per 100 m²) of Atlantic salmon small parr (age-1) by tributary of the Restigouche River.

Year	Kedgwick	Little Main	Patapedia	Upsalquitch	Matapedia	Main stem
1972	2.2	1.4		0.0		4.5
1973	3.8	1.2		2.9		1.6
1974	7.3	6.6		9.1		3.6
1975	7.1	8.3		18.4		11.6
1976	9.5	5.1		15.2		8.4
1977	5.1	2.9		6.4		4.0
1978	5.7	7.2		14.0		6.6
1979	6.4	5.6		12.1		4.9
1980	5.4	1.1		5.1		5.0
1981	2.7	2.3		4.7		4.6
1982	2.2	3.4		5.2		6.5
1983	6.6	5.1		7.2		8.2
1984	5.3	3.7		4.8		6.4
1985	9.5	8.5		10.2		12.2
1986	7.8	2.9		7.5		10.7
1987	10.4	3.7				19.7
1988	6.9	1.1				15.3
1989	14.4	3.8				23.5
1990	14.7	2.5				32.1
1991	14.5	3.5				21.9
1992	14.1	5.5				33.7
1993	12.4	2.3				31.1
1994	9.6	2.4				27.6
1995	20.6	3.9				15.4
1996	11.5	4.8				7.1
1997	18.6	12.2		13.7		16.5
1998	19.6	12.3		36.9		12.7
1999	13.5	10.5		28.0		24.2
2000	29.8	24.8		32.0		24.5
2001	24.3	16.4	41.1	23.5	36.3	16.8
2002	20.2	17.8	35.1	13.0	21.3	15.8
2003	29.1	21.6		17.4		23.6
2004	14.6	8.8	32.0	8.1	22.3	14.7
2005	15.5	9.9	38.1	30.9	9.1	22.2
2006	22.7	10.9	31.0	13.0	20.1	11.3
2007	18.2	13.9	31.8	22.7	19.8	17.4
2008	7.4	3.9	12.9	6.1	4.5	6.1

Table 10. Mean density (fish per 100 m²) of Atlantic salmon large parr (age-2) by tributary of the Restigouche River.

Year	Kedgwick	Little Main	Patapedia	Upsalquitch	Matapedia	Main stem
1972	1.4	0.5		0.0		0.3
1973	1.3	0.7		0.9		0.1
1974	0.9	0.5		0.8		0.1
1975	2.4	1.1		5.2		3.6
1976	1.6	1.0		2.6		1.4
1977	2.3	0.7		1.3		1.8
1978	1.1	1.0		2.4		0.7
1979	1.2	1.5		3.3		0.9
1980	1.1	0.7		2.1		2.4
1981	0.3	0.3		1.3		0.6
1982	0.2	0.4		0.9		0.3
1983	2.1	1.6		2.7		3.6
1984	2.1	0.5		1.1		2.0
1985	1.5	0.7		1.6		2.9
1986	3.4	1.4		1.1		4.5
1987	5.7	1.9				7.7
1988	1.6	2.3				4.0
1989	1.9	1.3				3.6
1990	2.6	2.1				7.3
1991	1.8	0.6				8.0
1992	1.6	0.2				10.3
1993	6.3	2.4				4.1
1994	1.8	0.3				8.2
1995	2.6	3.4				1.2
1996	1.1	2.6				0.5
1997	3.5	2.5		5.0		1.9
1998	3.7	2.6		6.1		2.4
1999	7.7	3.4		9.0		7.8
2000	5.9	3.7		12.5		11.7
2001	4.1	2.6	11.0	4.6	8.7	3.8
2002	8.9	4.7	18.5	7.1	19.1	7.2
2003	8.8	3.2		5.0		6.0
2004	7.4	3.6	16.1	6.1	10.9	7.2
2005	8.4	3.8	14.9	7.0	7.1	8.4
2006	9.6	6.7	18.8	8.2	11.5	9.8
2007	8.2	5.8	10.5	3.6	7.9	4.6
2008	3.0	1.5	8.1	3.1	2.9	4.1

Table 11. Smolt production from Restigouche and Kedgwick rivers 2003 to 2008. Weight (g) is the predicted mean weight for a smolt measuring 130 mm. Smolt run size estimates for Kedgwick River in 2005 are minimum value due to high water conditions.

River	Smolt Year	Run size estimates Estimate	95% Conf. Interval		Smolts per 100 m² Estimate	95% C.I.	Size (mean) Length (mm)	Weight (g)	Prop. Female	Proportion at freshwater age 2	3	4
										.	.	.
Restigouche River	2003	379,000	262,000	670,000	1.8	1.0 - 2.5	125	23.2	0.32	.	.	.
	2004	449,000	289,000	613,000	2.1	1.1 - 2.3	130	20.2	0.53	.	.	.
	2005	630,000	450,000	1,010,000	2.9	1.7 - 3.8	125	19.7	0.72	0.02	0.95	0.03
	2006	500,000	300,000	1,275,000	1.9	1.1 - 4.8	130	21.4	0.73	0	1	0
	2007	1,087,800	760,000	1,621,000	4.1	2.9 - 6.1	120	20.9	0.63	0	0.97	0.03
	2008	486,800	364,000	686,700	1.8	1.4 - 2.6	120	19.2	0.62	0	1	0
Kedgwick River	2002	.	.	.	.	.	125	19.4	0.54	.	.	.
	2003	91,800	55,100	128,600	2.6	1.6 - 3.7	130	22.4	0.44	.	.	.
	2004	131,500	74,200	191,400	3.8	2.1 - 5.5	130	22.1	0.53	0.06	0.9	0.04
	2005	*67,000*	*51,000*	*96,500*	1.9	1.5 - 2.8	125	22.2	0.60	0.05	0.95	0.00
	2006	*129,500*	*87,500*	*245,000*	3.7	2.5 - 7.0	125	19.0	0.40	0	0.98	0.02
	2007	105,800	88,800	127,400	3.0	2.5 - 3.6	125	19.8	0.60	0	0.97	0.03
	2008	110,000	10,182	210,071	3.1	0.3 - 6.0	125	18.6	0.49	0.03	0.96	0.10

Table 12. Data and estimation of total returns and spawners of large salmon to SFA 15. Midpoints (assuming 40% exploitation rate in the angling fishery of the Restigouche River) are shown.

	Harvests				Restigouche NB				SFA 15			Angling ratio	Restigouche Large Salmon			SFA 15 Large Salmon	
	Commercial	Native harvests for Restigouche			Angling catch			Angling	Angling catch			SFA 15 /	Return			Return	
Year	Chaleur Bay NB side	Estuary NB	Quebec	Inriver NB	Kept	Released	Catch	loss	Kept	Released	Catch	Restigouche NB	Post-comm.	Total	Spawners	Pre-comm	Spawners
1970	9,124				1716		1716	1,716					4290	13414	2574	14027	2942
1971	3,949				757		757	757					1893	5842	1136	6112	1298
1972	419				3870		3870	3,870					9675	10094	5805	11477	6635
1973	628				3746		3746	3,746					9365	9993	5619	11332	6422
1974	31				4785		4785	4,785					11963	11994	7178	13703	8203
1975	900	132			2160		2160	2,160					5532	6432	3240	7223	3703
1976	183	124	1517		4481		4481	4,481					11327	11510	6722	13128	7682
1977	211	212	2738		5128		5128	5,128					13032	13243	7692	15106	8791
1978	156	129			3373		3373	3,373					8562	8718	5060	9941	5783
1979	671	148	748		997		997	997					2641	3312	1496	3689	1709
1980	9	264	1563		4098		4098	4,098					10509	10518	6147	12020	7026
1981	3,647	211			2832		2832	2,832					7291	10938	4248	11980	4855
1982	3,798	155	1521		1620		1620	1,620	2,024		2,024	1.249	4205	8003	2430	8604	2777
1983	2,522	260	1216		1481		1481	1,481	1,811		1,811	1.223	3963	6485	2222	7051	2539
1984	535	213	1070			1672	1672	100					4393	4928	4080	5556	4663
1985	0	241	976			3563	3563	214		3,693	3,693	1.036	9149	9149	8694	10456	9936
1986	0	431	1145			4763	4763	286		5,390	5,390	1.132	12339	12339	11622	14102	13283
1987	0	916	986			3203	3203	192		3,746	3,746	1.170	8924	8924	7815	10199	8932
1988	0	509	921			4546	4546	273		5,238	5,238	1.152	11874	11874	11092	13571	12678
1989	0	568	1081			3441	3441	206		3,993	3,993	1.160	9171	9171	8396	10481	9596
1990	0	471	1135			2842	2842	171		3,222	3,222	1.134	7576	7576	6934	8659	7926
1991	0	252	859			2181	2181	131		2,541	2,541	1.165	5705	5705	5322	6520	6082
1992	0	464	948	10		3351	3351	201		3,752	3,752	1.120	8852	8852	8176	10117	9345
1993	0	293	901	8		1541	1541	92		1,843	1,843	1.196	4154	4154	3760	4747	4297
1994	0	348	989	32		3016	3016	181		3,468	3,468	1.150	7920	7920	7359	9052	8411
1995	0	178	989	24		1926	1926	116		2,226	2,226	1.156	5017	5017	4699	5734	5371
1996	0	176	989	37		2822	2822	169		3,242	3,242	1.149	7268	7268	6886	8307	7870
1997	0	155	989	11		1772	1772	106		2,072	2,072	1.169	4596	4596	4324	5253	4942
1998	0	197	989	37		1157	1157	69		1,327	1,327	1.147	3127	3127	2823	3573	3227
1999	0	230	989	22		1210	1210	73		1,310	1,310	1.083	3277	3277	2952	3746	3374
2000	0	230	989	22		1574	1574	94		1,919	1,919	1.219	4187	4187	3841	4786	4390
2001	0	230	989	22		2694	2694	162					6987	6987	6573	7986	7513
2002	0	230	989	22		1622	1622	97					4307	4307	3958	4923	4523
2003	0	230	989	22		2818	2818	169					7297	7297	6876	8340	7859
2004	0	230	989	22		2119	2119	127					5550	5550	5170	6343	5909
2005	0	230	989	22		2429	2429	146					6325	6325	5927	7229	6774
2006	0	230	989	22		1782	1782	107					4707	4707	4348	5380	4970
2007	0	230	989	22		3056	3056	183					7892	7892	7457	9020	8522
2008	0	230	989	22		1808	1808	108					4772	4772	4412	5455	5042

Table 13. Data and estimation of total returns and spawners of small salmon to SFA 15. Midpoints (assuming 40% exploitation rate in the angling fishery of the Restigouche River) are shown.

	Harvests				Restigouche NB				SFA 15			Angling ratio	Restigouche Small Salmon			SFA 15 Small Salmon	
	Commercial	Native harvest for Restigouche			Angling catch			Angling	Angling catch			SFA 15 /	Return			Return	
Year	Chaleur Bay NB side	Estuary NB	Quebec	Inriver NB	Kept	Released	Catch	loss	Kept	Released	Catch	Restigouche NB	Post-comm.	Total	Spawners	Pre-comm	Spawners
1970					1340		1340	1.340					3350	3350	2010	4159	2495
1971					999		999	999					2498	2498	1499	3101	1860
1972	116				978		978	978					2445	2561	1467	3295	1821
1973					1423		1423	1.423					3558	3558	2135	4416	2650
1974	31				1038		1038	1.038					2595	2626	1557	3291	1933
1975		3			1130		1130	1.130					2828	2828	1695	3511	2104
1976	3,694	13			2345		2345	2.345					5876	9570	3518	15574	4367
1977	1,132	19			2333		2333	2.333					5852	6984	3500	9802	4344
1978	1,531	23			1322		1322	1.322					3328	4859	1983	7563	2462
1979	85	84			1990		1990	1.990					5059	5144	2985	6471	3706
1980	1,968	34			2833		2833	2.833					7117	9085	4250	13246	5276
1981	2,994	20			3010		3010	3.010					7545	10539	4515	16078	5605
1982	901	12			2449		2661	2.449	2.866		2.866	1.077	6665	7566	4204	10293	5218
1983	1,147	0			715		745	715	941		941	1.263	1863	3010	1148	4883	1425
1984	8,823	1			1474		1503	1.474	2.113		2.113	1.406	3759	12582	2284	24442	2835
1985		0			3258		3311	3.258	3.639		3.639	1.099	8278	8278	5020	10276	6231
1986		26			4915		5100	4.915	5.961		5.961	1.169	12776	12776	7835	15861	9727
1987		95			4414		4508	4.414	5.386		5.386	1.195	11365	11365	6856	14109	8511
1988		70			6084		6193	6.084	7.278		7.278	1.175	15553	15553	9399	19308	11668
1989		151			2851		2934	2.851	3.652		3.652	1.245	7486	7486	4484	9293	5567
1990		120			3559		3669	3.559	4.277		4.277	1.166	9293	9293	5614	11536	6969
1991		10			1987		2095	2.095	2.894		2.894	1.381	5248	5248	3143	6514	3901
1992		2		0	3999	169	4168	4.009	5.157	499	5.656	1.357	10422	10422	6411	12938	7959
1993		0		0	2472	201	2673	2.484	3.111	286	3.397	1.271	6683	6683	4198	8296	5212
1994		29		29	3942	288	4230	3.959	4.611	368	4.979	1.177	10633	10633	6616	13200	8213
1995		0		21	1235	120	1355	1.242	1.646	220	1.866	1.377	3409	3409	2145	4231	2663
1996		0		77	2629	190	2819	2.640	3.079	320	3.399	1.206	7125	7125	4407	8845	5471
1997		0		26	2448	250	2698	2.463	2.648	300	2.948	1.093	6771	6771	4282	8406	5316
1998		0		26	2198	711	2909	2.241	2.348	796	3.144	1.081	7299	7299	5032	9061	6247
1999		6		36	1794	517	2311	1.825	2.094	667	2.761	1.195	5819	5819	3952	7224	4907
2000		6		36	2208	1275	3483	2.285	2.658	1.725	4.383	1.258	8749	8749	6423	10862	7974
2001		6		36			2336	2.336					5882	5882	3504	7302	4350
2002		6		36			5538	5.538					13887	13887	8307	17239	10313
2003		6		36			1472	1.472					3722	3722	2208	4620	2741
2004		6		36			5714	5.714					14327	14327	8571	17786	10640
2005		6		36			1944	1.944					4902	4902	2916	6085	3620
2006		6		36			4122	4.122					10347	10347	6183	12845	7676
2007		6		36			2011	2.011					5069	5069	3017	6293	3745
2008		6		36			5973	5.973					14974	14974	8960	18590	11123

Table 14. Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic salmon in SFA 15, Northern NB (DFO and MNRF. *In prep).*

Potential sources of mortality /harm Permitted and un-permitted activities	**Source** ***(with examples)***	**Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN**	**Cause/ Time Frame Historic (H) Current (C) Potential (P)**	**Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)**	**Management Alternatives/ Mitigation** ***(relative to existing actions)***
Directed Salmon Fishing	Aboriginal	**Low**	**C**	**Low**	Control harvest through agreements between DFO and First Nations
	Recreational: retention & release	**Low**	**C**	**Low** –1SW retention only	Encourage the use of catch and release measures
	Commercial (domestic)	**Not Applicable –** all commercial fisheries closed			
	High Seas (West Greenland / St. Pierre – Miquelon)	**Low**	**H C**	**Low**	Reductions in internal use fisheries in those areas
	Illegal (poaching)	**Low**	**C**	**Low** – increased enforcement in conjunction with DFO and provincial enforcement officers, increased stewardship initiatives with local groups, changed enforcement strategies for more targeted efforts	Continue use of compliance monitors on selected watersheds, including Aboriginal guardians
	CUMULATIVE EFFECT	**LOW– MEDIUM**	**C**	**LOW – MEDIUM**	

Table 14 (continued).

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Bycatch of Salmon in Fisheries for Other Species	Aboriginal	**Low**	**C**	**Low**– all bycatch mandatory release	
	Recreational	**Low**	**C**	**Low**– all bycatch mandatory release	
	Commercial near-shore	**Low**	**C**	**Low**– all bycatch mandatory release	
	Commercial distant	**Low**	**C**	**Low**	None apparent
	CUMULATIVE EFFECT	**LOW**		**LOW**	None apparent
Salmon Fisheries Impacts on Salmon Habitat	Aboriginal	**Low**	**C**	**Low**	None apparent
	Recreational	**Low**	**C**	**Low**	None apparent
	Commercial	**Not Applicable**– all commercial fisheries closed			
	Illegal	**Low**	**C**	**Low**	None apparent
	CUMULATIVE EFFECT	**LOW**	**C**	**LOW**	None apparent
Mortality Associated with Water Use	Power generation at dams & tidal facilities (turbine mortality, entrainment, stranding)	**Low – Medium**	**H C**	**Low**	Thermal generation stations in Dalhousie and Belledune, NB, must comply with conditions of operating license and sec 22 of the *Fisheries Act*

Table 14 (continued).

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Habitat Alterations	Municipal waste water treatment facilities	**Low**	**H C P**	**Low** – few communities	Ensure current projects and future developments meet standards
	Pulp & paper mills	**Low**	**H C**	**Low –** pulp and paper mills comply with pulp and paper effluent regulations	
	Hydroelectric power generation (dams & reservoirs, tidal power): altered behavior & ecosystems	**Low– Medium**	**H C P**	**Low – Medium**	Must comply with sec. 22 and 35 of the *Fisheries Ac.*
	Water extractions	**Low**	**H C P**	**Low**	Must meet regulations in place; monitoring; develop regional guidelines
	Urbanization (altered hydrology)	**Low**	**H C P**	**Low** – only small communities	Project redesign/ existing regulation - monitoring
	Infrastructure (roads/culverts) (fish passage)	**Medium**	**H C P**	**Medium** – many non compliant culverts	More monitoring/ enforcement of existing regulations
	Aquaculture siting	**Not Applicable**			

Table 14 (continued).

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Habitat Alterations	Agriculture / Forestry / Mining, etc.	**Medium**	**H C P**	**Medium** – potential mineral processing; past mining/ processing	Enforcement/ monitoring of existing suite of regulations; compensations where required
	Municipal, provincial & federal dredging	**Low**	**H C P**	**Low**	Follow regulations in place; mitigations and compensations as required; minimize amount
	CUMULATIVE EFFECT	**MEDIUM**	**H C P**	**MEDIUM**	None apparent
Shipping, Transport and Noise	Municipal, provincial, federal & private transport activities (inc. land and water based contaminants/ spills)	**Uncertain**	**H C P**	**Uncertain**	None apparent
Fisheries on Prey of Salmon (for ex. capelin, smelt, shrimp)	Commercial, Recreational, Aboriginal fisheries for species a, b, c etc.	**Uncertain**	**H C**	**Uncertain**	None apparent
Aquaculture (Salmon and other species)	Escapes from fresh water, marine facilities, disease, parasites, competition, effects on behaviour and migration, genetic introgression	**Low**	**H C P**	**Low**	Fish health regulations, Introduction and transfer regulation
Fish culture / stocking (non-commercial, including private, NGO, government)	Impacts on effective population size, over representation of families, domestication	**Low**	**H C P**	**Low**	Must comply with Introduction and Transfers guidelines.

Table 14 (continued).

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Scientific Research	Government, university, community and Aboriginal groups	**Low**	**C**	**Low** – minimal removals for scientific purposes.	None apparent
Military Activities	Field operations, shooting ranges	**Not Applicable**			
Air Pollutants	Acid rain	**Low**	**H P**	**Uncertain**	None apparent
UN-PERMITTED					
Introductions of non-native / invasive species	Smallmouth bass, chain pickerel, muskellunge, rainbow trout, invertebrates, plants, algae	**Uncertain**		**Uncertain**	Increase monitoring and enforcement activities Conduct education programs
International High Seas Targeted	Flags of convenience?	**Uncertain**		**Uncertain**	None apparent
Ecotourism and Recreation	Private Co's & public at large (water crafts, swimming, etc) effects on salmon behaviour & survival	**Medium**	**H C P**	**Low**	Conduct education programs Increase enforcement activities

Table 14 (continued).

Potential sources of mortality /harm Permitted and un-permitted activities	Source (*with examples*)	Proportion of salmon affected LOW < 5%, MEDIUM 5% to 30%, HIGH > 30%, UNCERTAIN	Cause/ Time Frame Historic (H) Current (C) Potential (P)	Effect on Population (LOW < 5% spawner loss, MEDIUM 5% to 30% spawner loss, HIGH > 30% spawner loss, UNCERTAIN)	Management Alternatives/ Mitigation *(relative to existing actions)*
Ecosystem change	Climate change, changes in relative predator / prey abundances, disease	**Low – Uncertain**	C P	**Low – Uncertain**; some rivers in this area are moderately impacted by low water levels and warm water temperatures; affect on salmon populations is unknown.	None apparent
Fish diseases	Furunculosis	**Low**	H C	**low**	

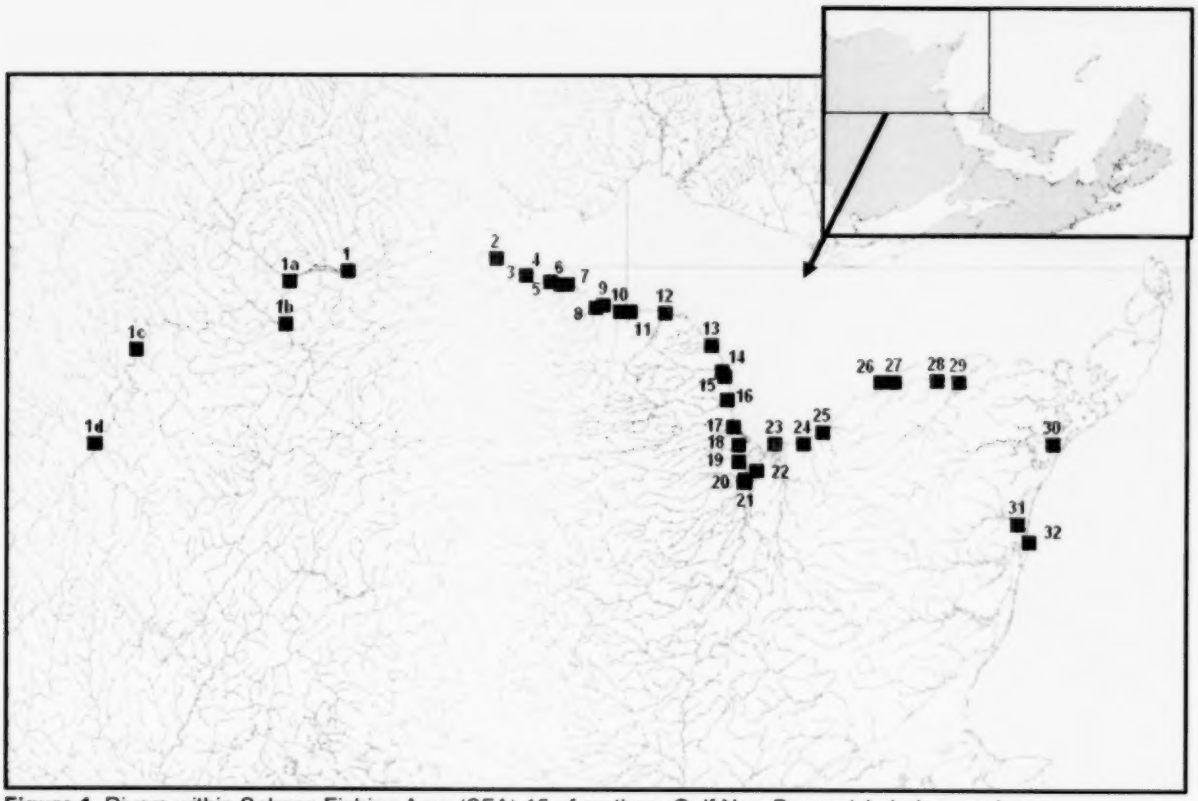

Figure 1. Rivers within Salmon Fishing Area (SFA) 15 of northern Gulf New Brunswick. Index numbers refer to rivers in Table 1. Index numbers 1a to 1d refer to position of major tributaries of the Restigouche River (Index 1): 1a = Matapedia, 1b = Upsalquitch, 1c = Patapedia, 1d = confluence of Kedgwick and Little Main Restigouche.

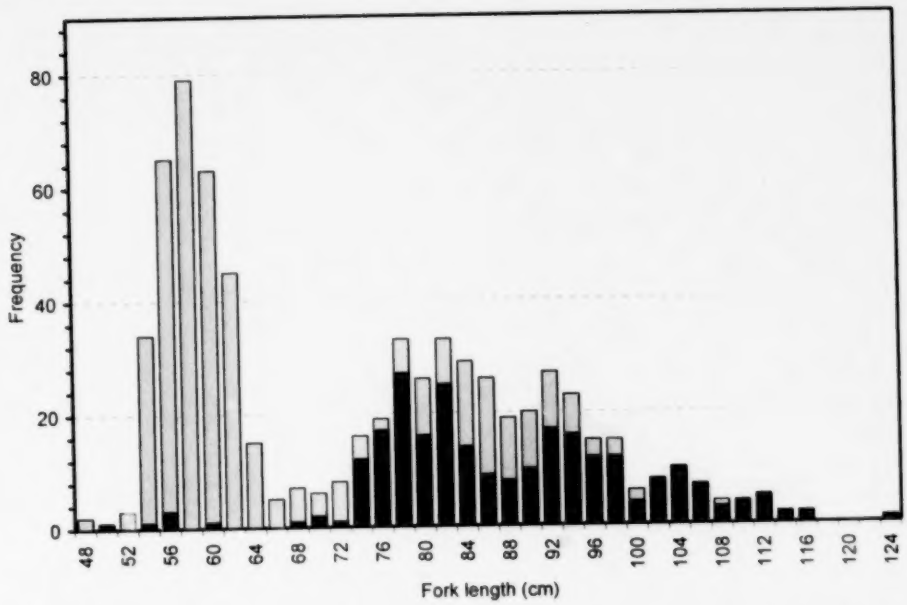

Figure 2. Example of size distribution (fork length cm) for male and female salmon from the Restigouche River. Samples are from the year 2000 from multiple locations within the river.

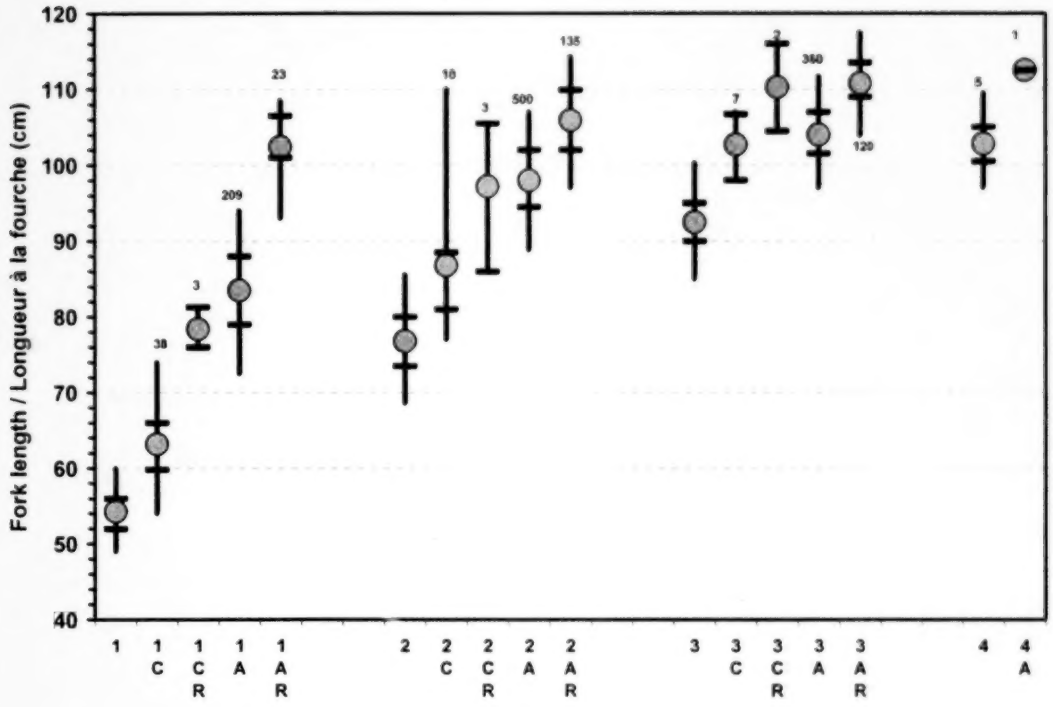

Figure 3. Fork length (cm) at age defined by sea age and spawning history for Atlantic salmon from the Restigouche River. Bullet is the median, horizontal hatches are interquartile range, vertical bars are 95% confidence interval range. Number above the plots is the sample size. Sea age histories are interpreted as follows: 1, 2 and 3 corresponding sea age of maiden first time spawners; -C are consecutive second time spawners; -CR are repeat spawners on a third or greater spawning migration which returned to a second spawning as consecutives; -A are alternate second time spawners; -AR are repeat spawners on a third or greater spawning migration which returned to a second spawning as alternates. A consecutive spawner is a fish which returned to the river to spawn within the same year as it left the river in the spring as a kelt. An alternate spawner is a fish which spent more than twelve months at sea before returning to spawn after having left the river in the spring as a kelt.

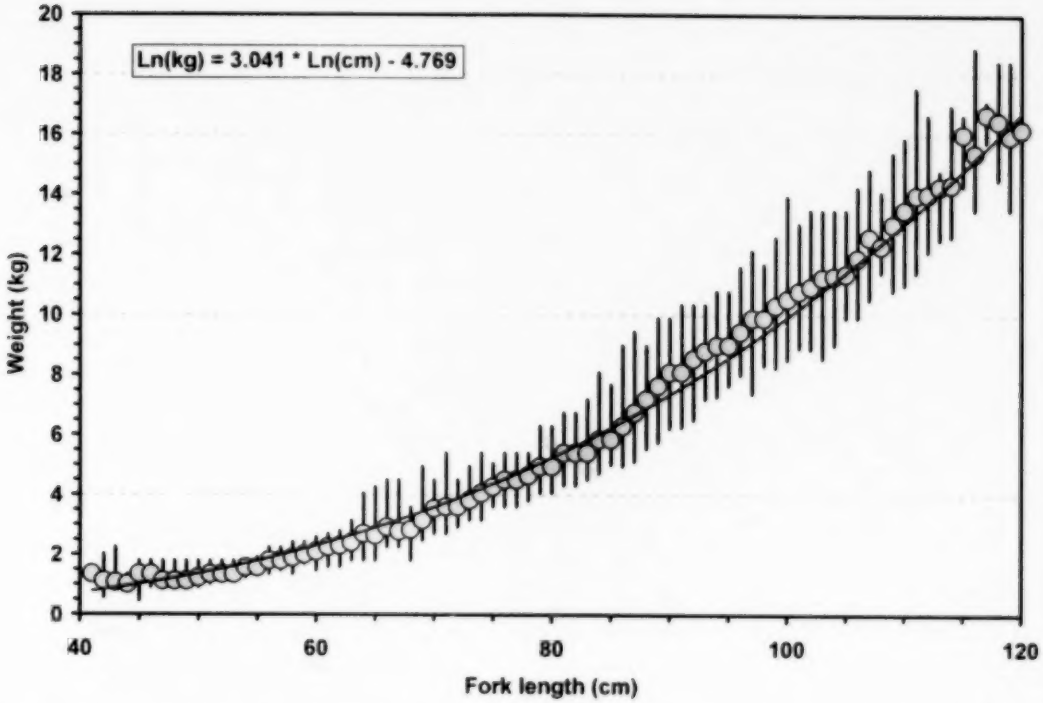

Figure 4. Weight to length relationship for Atlantic salmon from the Restigouche River. Median, 5th and 95th percentile ranges are shown. Data are from the period 1972 to 1984.

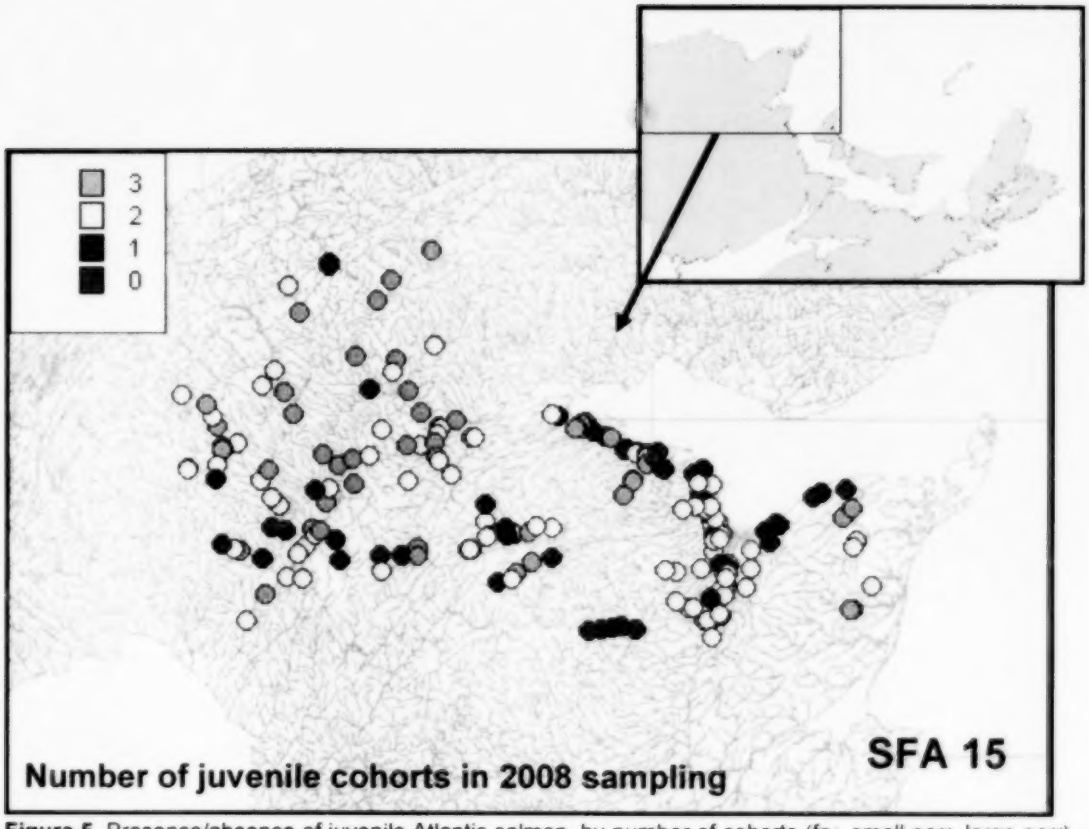

Figure 5. Presence/absence of juvenile Atlantic salmon, by number of cohorts (fry, small parr, large parr) at electrofishing sites in rivers of SFA 15 sampled in 2008.

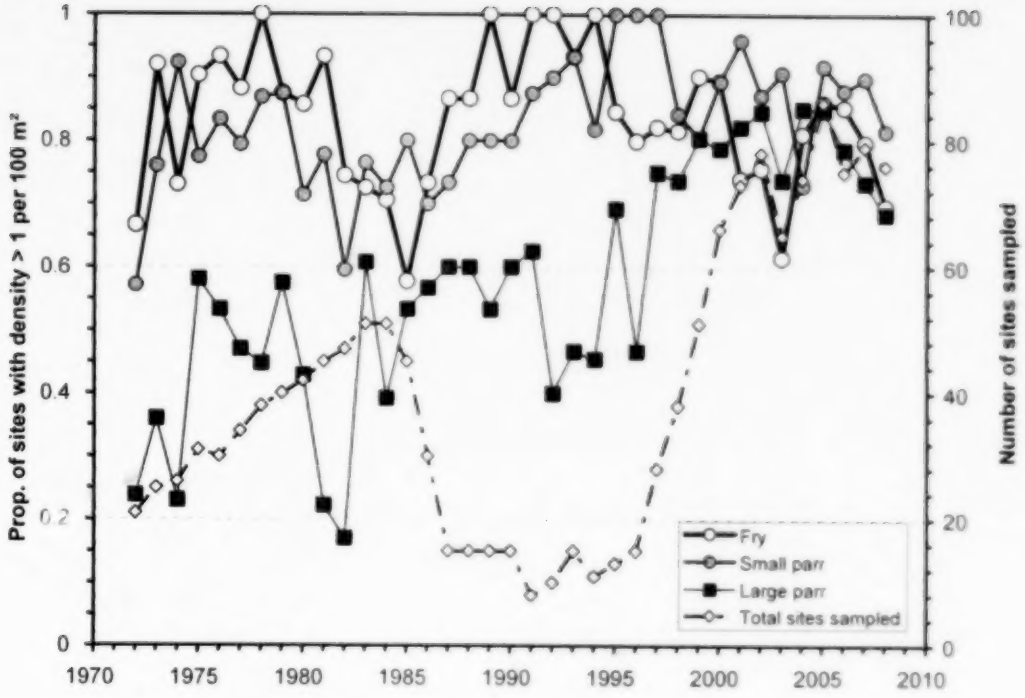

Figure 6. Proportion of sites sampled annually in Restigouche River (N.B.) containing more than 1.0 juvenile per 100 m^2 by age/size group.

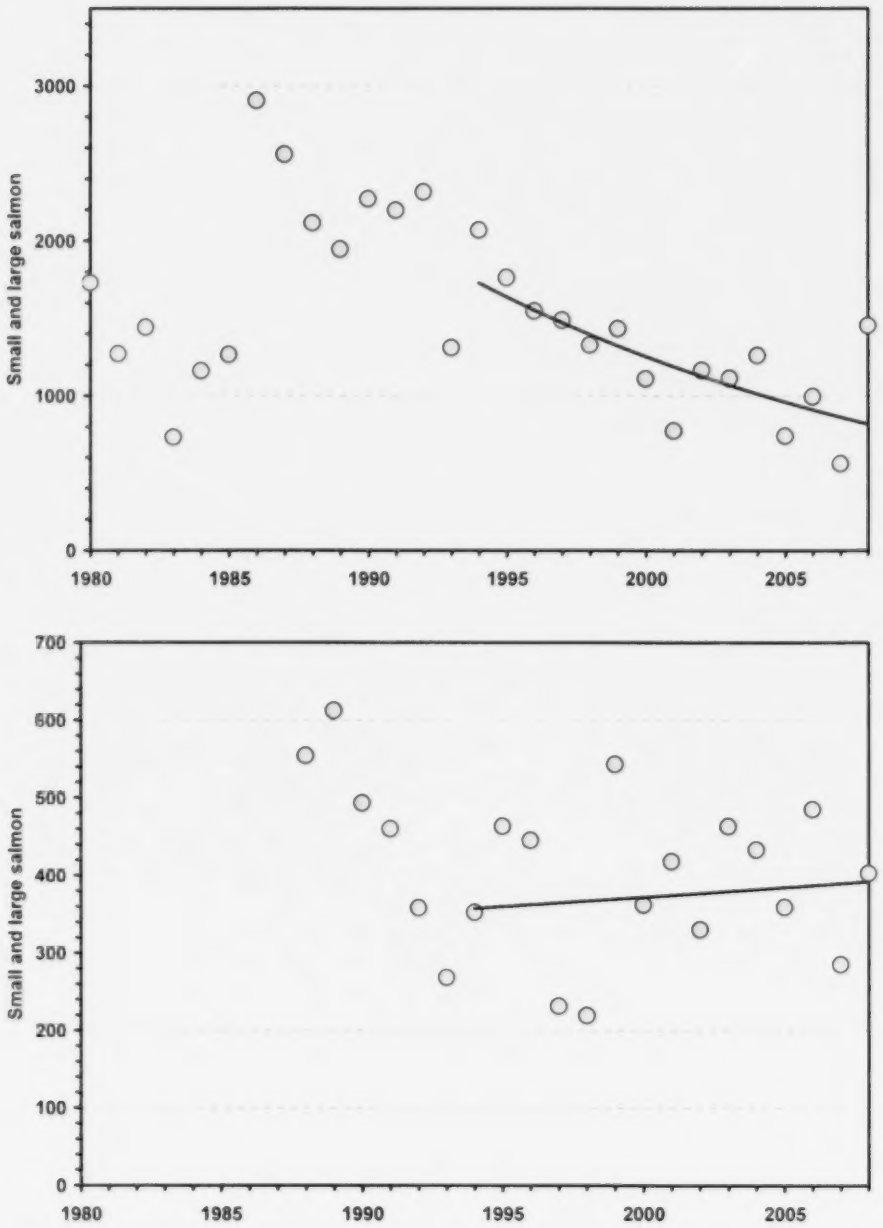

Figure 7. Counts of all adult salmon (small and large salmon combined) at the Northwest Upsalquitch Barrier (upper) and Causapscal Barrier (bottom), Restigouche River.

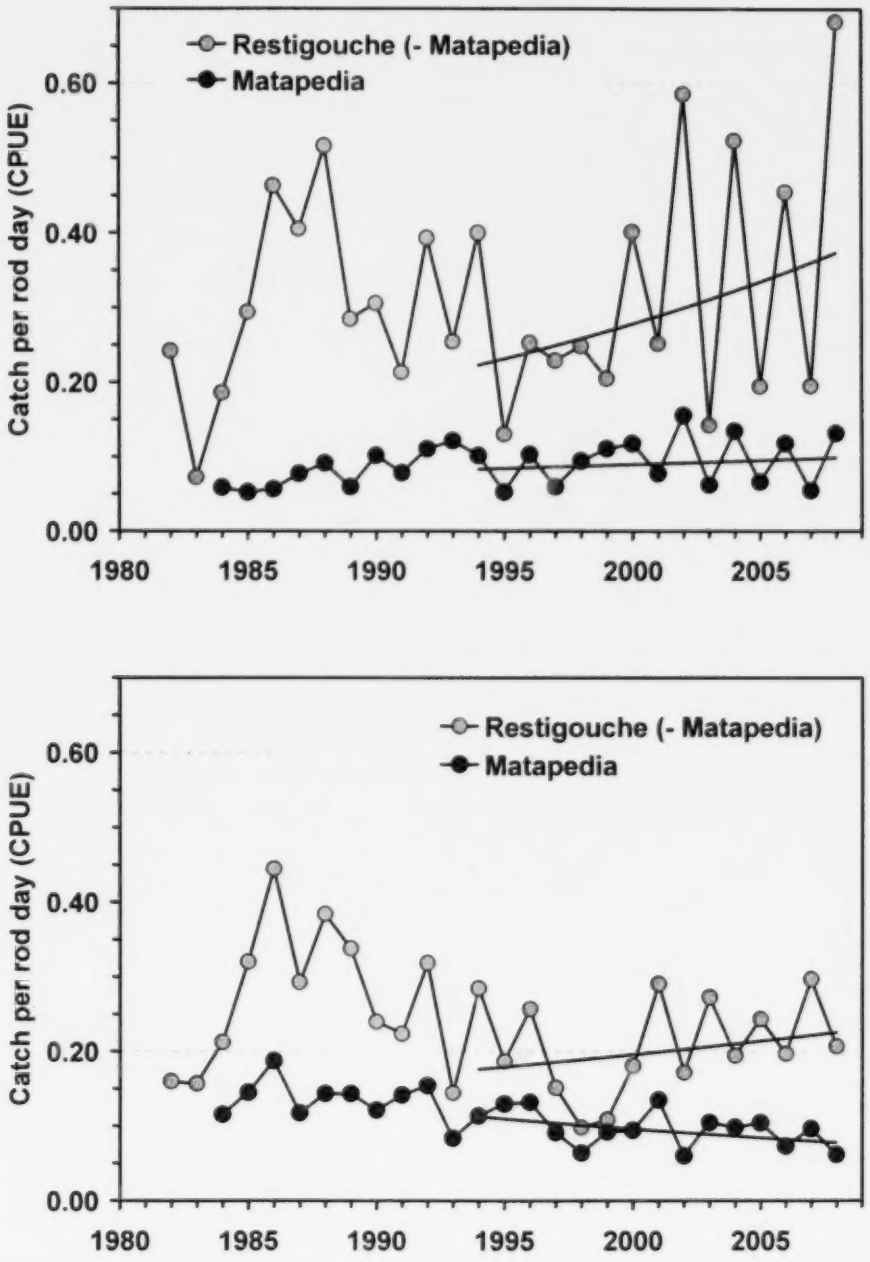

Figure 8. Catch per unit of effort (rod day) of small salmon (upper) and large salmon (lower) from Restigouche River (excluding Matapedia) and Matapedia River.

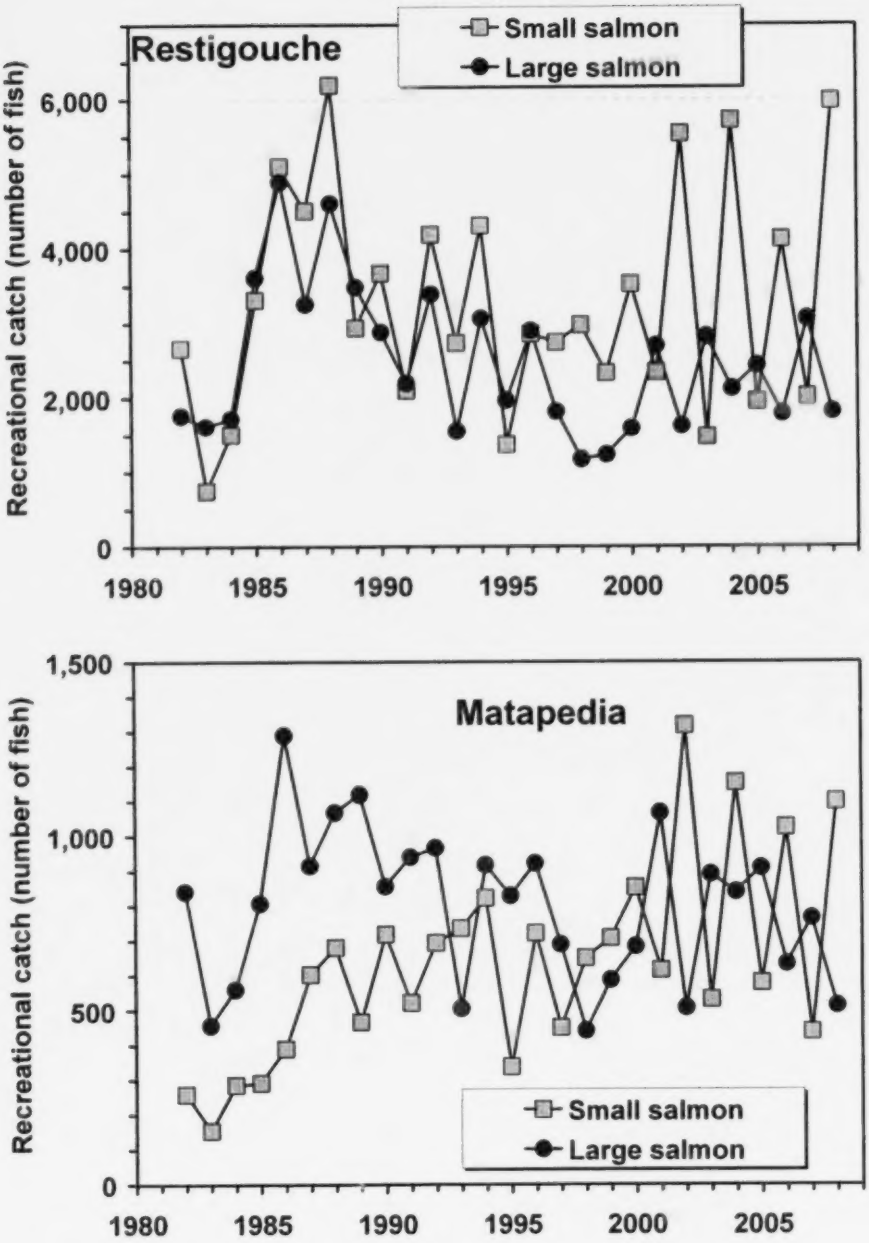

Figure 9. Angling catch of small and large salmon from Restigouche River (excluding Matapedia) (upper) and Matapedia River (lower).

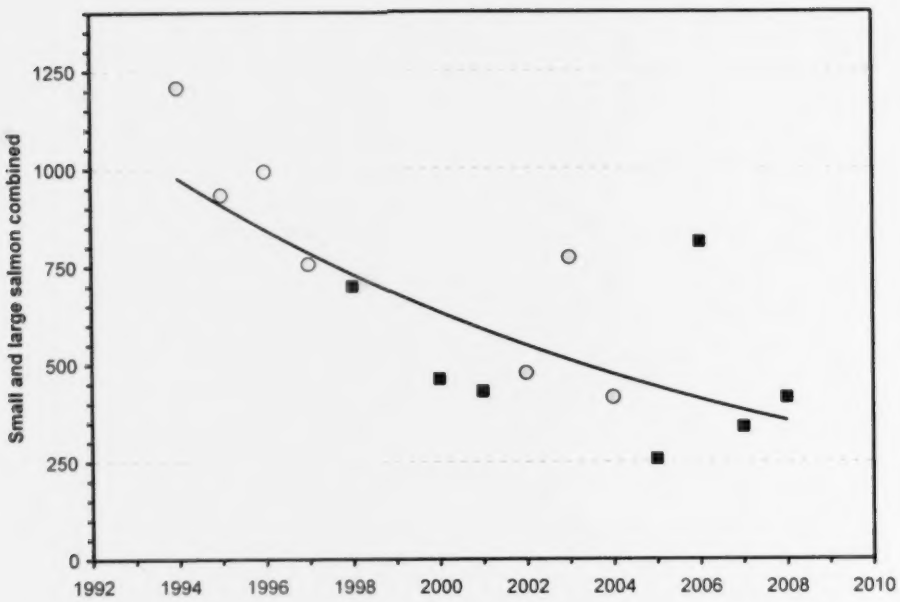

Figure 10. Counts of salmon at the Jacquet River barrier. Square black symbols show years with incomplete counts due to fence washouts or early removal due to inclement weather.

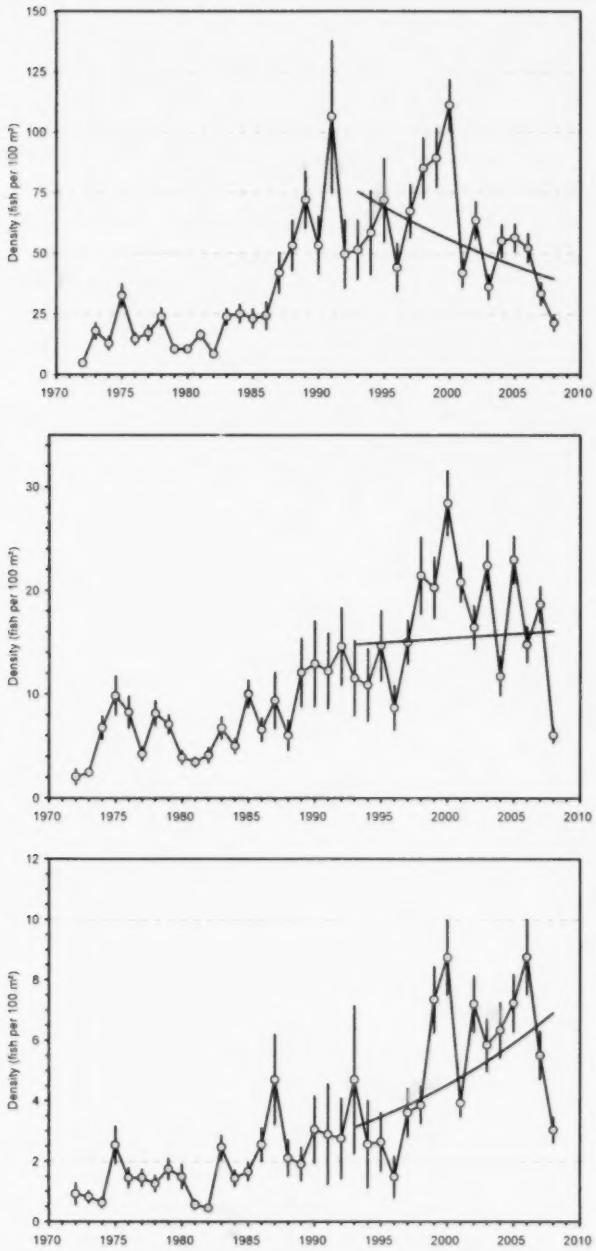

Figure 11. Juvenile abundance index for fry (upper), small parr (middle) and large parr (lower) for the sites sampled in the Restigouche River (NB waters only, excluding Matapedia)

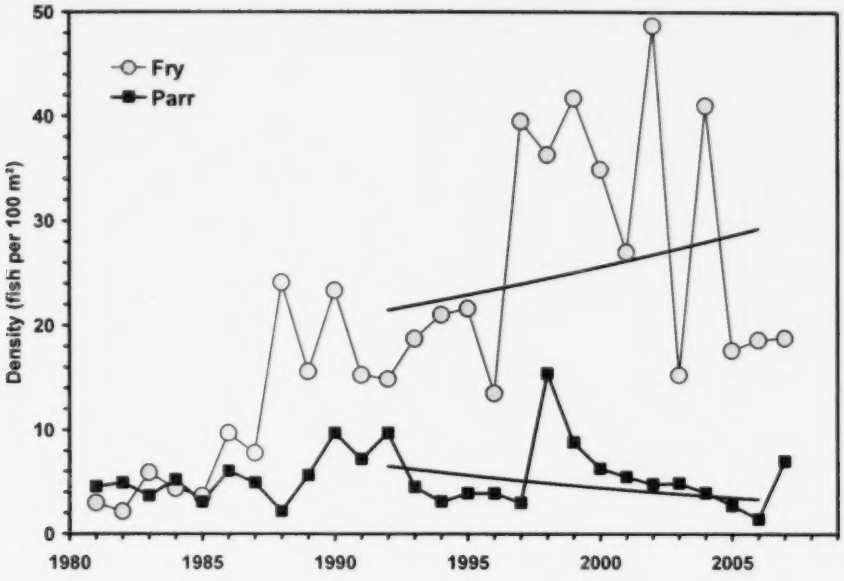

Figure 12. Juvenile indices of abundance from the Nepisiguit River.

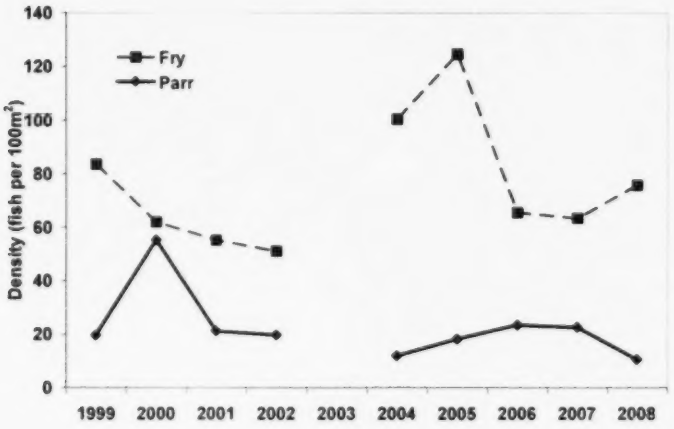

Figure 13. Juvenile indices of abundance from the Jacquet River.

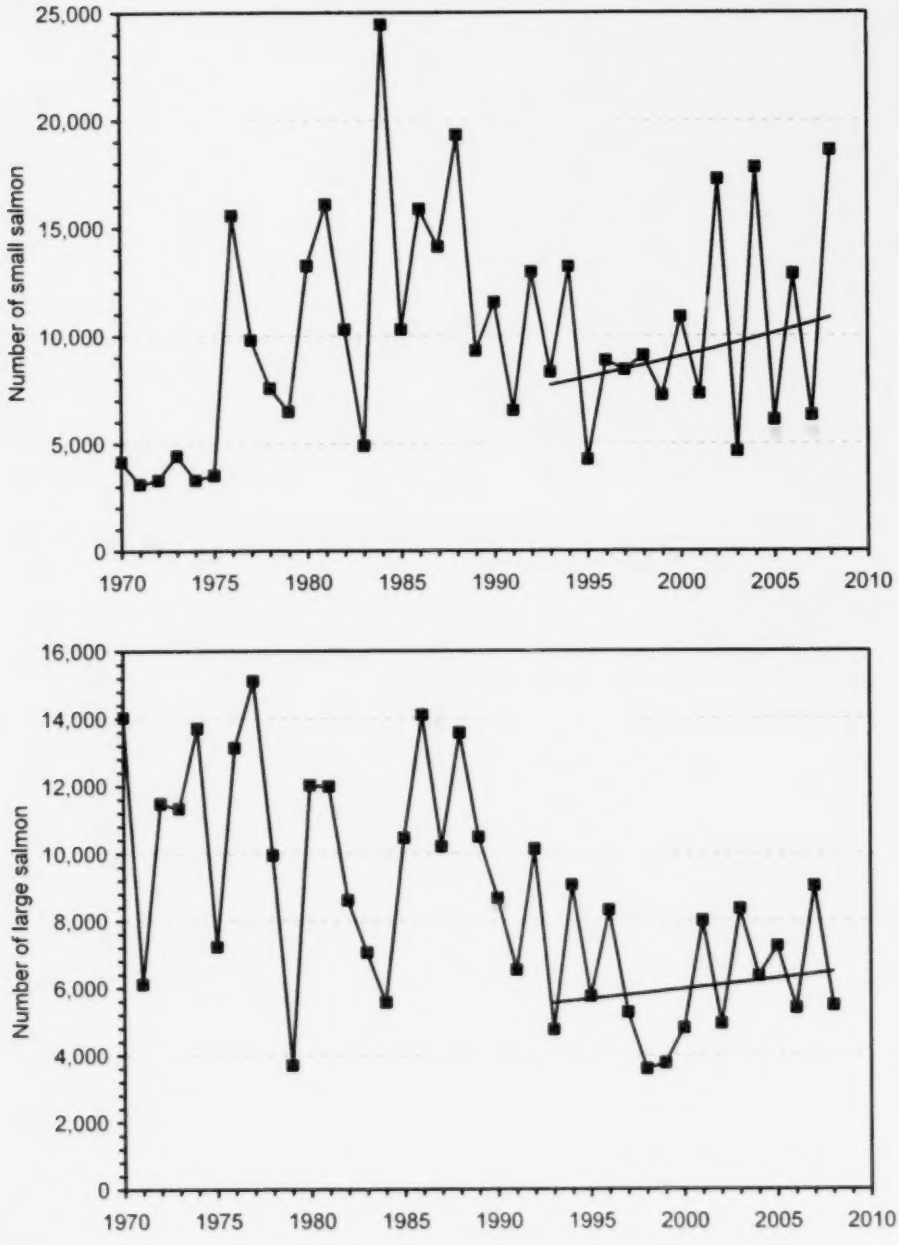

Figure 14. Estimated abundance (returns) of small salmon (upper) and large salmon (lower) to SFA 15, 1970 to 2008. Trend lines are shown for the period 1993 to 2008.